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Yang

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(54) **VIBRATION DAMPER, EXHAUST DIFFUSER SYSTEM, AND GAS TURBINE INCLUDING SAME**

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CPC ***F01D 25/04*** (2013.01); ***F01D 25/164*** (2013.01); *F05D 2220/32* (2013.01); *F05D 2260/96* (2013.01)

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See application file for complete search history.

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(57) **ABSTRACT**

A vibration damper capable of damping vibrations occurring from a turbine casing, an exhaust diffuser system including the vibration damper, and a gas turbine including the exhaust diffuser system are provided. The vibration damper installed on an outer casing of a gas turbine to damp vibrations generated in the gas turbine, the vibration damper includes a reinforcing support part including a plurality of reinforcing plates, a first flange coupled to both longitudinal ends of the reinforcing support part and fixed to a protruding support protruding from the outer casing, and a second flange disposed between the plurality of reinforcing plates to connect the plurality of reinforcing plates, wherein each of the plurality of reinforcing plates is erected and installed on an outer circumferential surface of the outer casing.

20 Claims, 9 Drawing Sheets

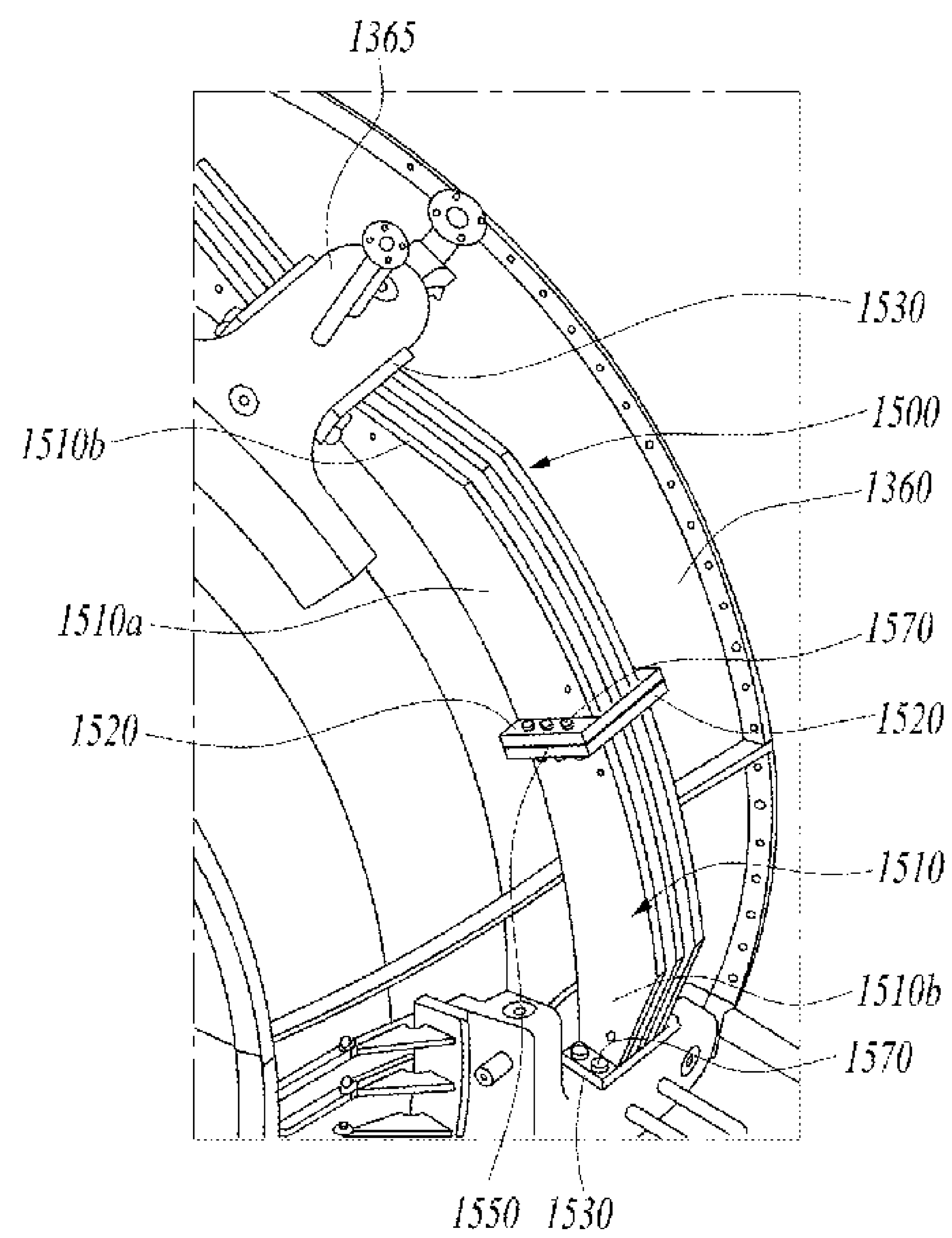

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FIG. 1

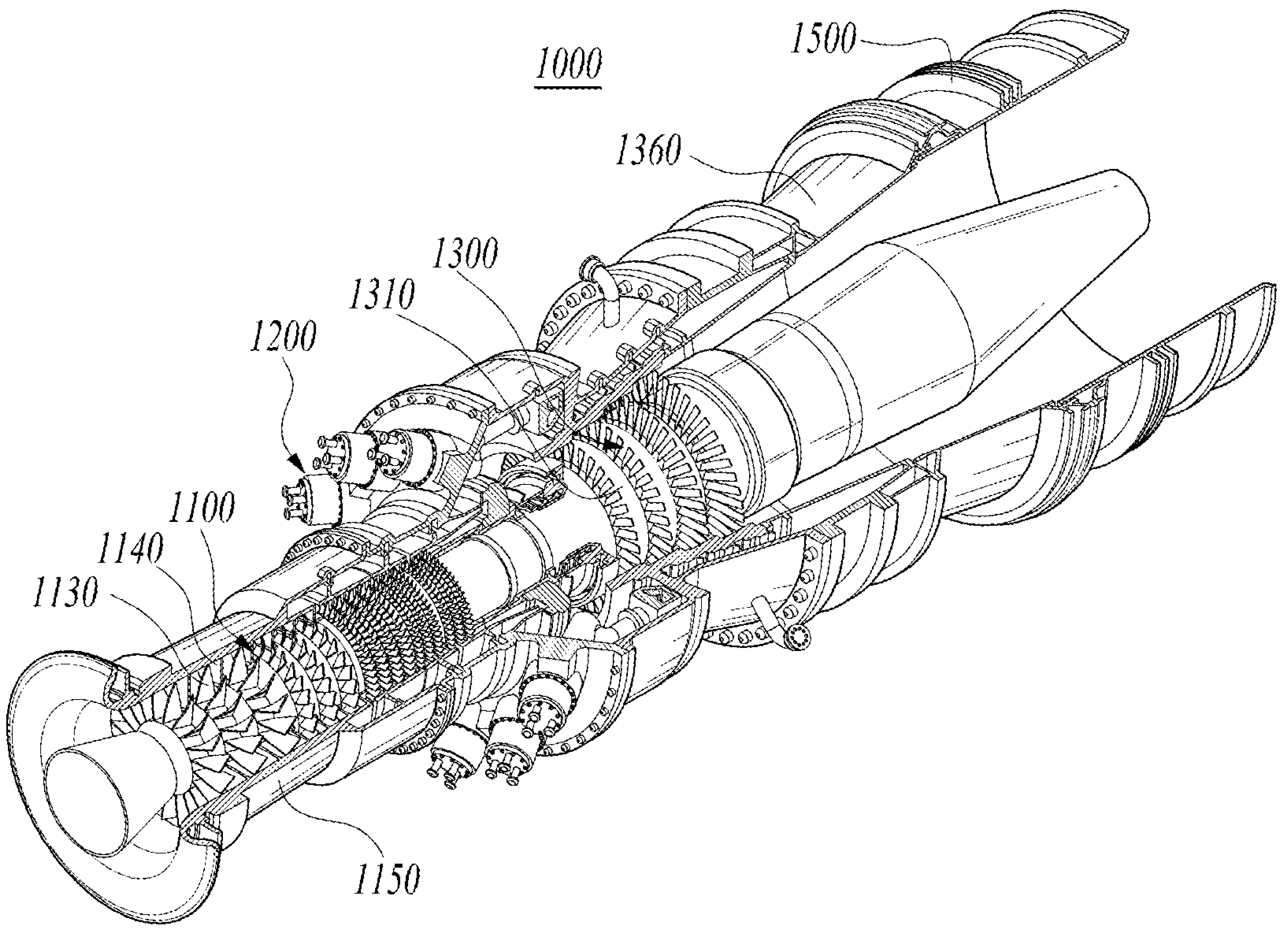


FIG. 2

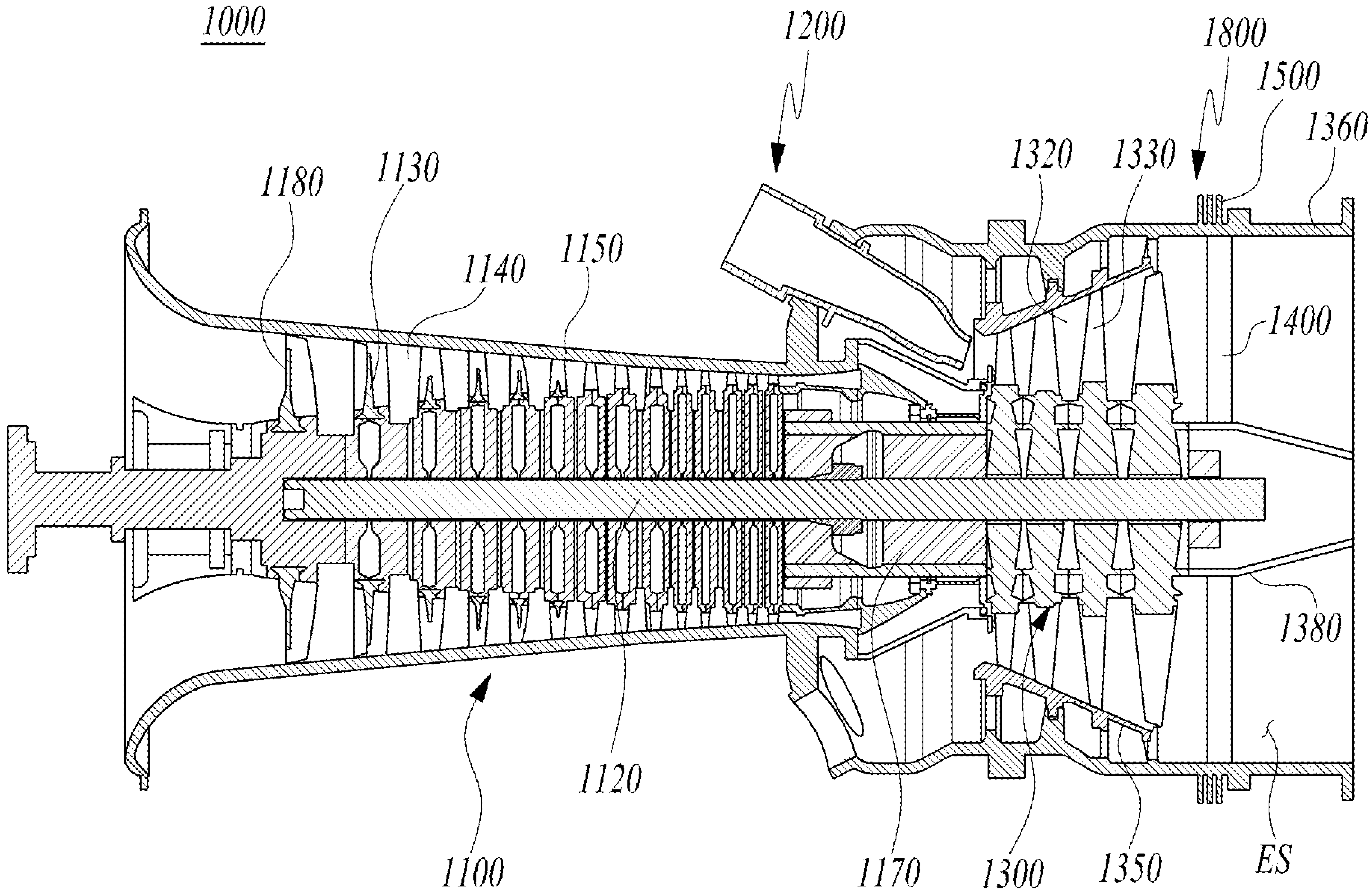

1000
1200
1800
1500
1360
1180
1130
1140
1150
1320
1330
1400
1380
1120
1100
1170
1300
1350
ES

FIG. 3

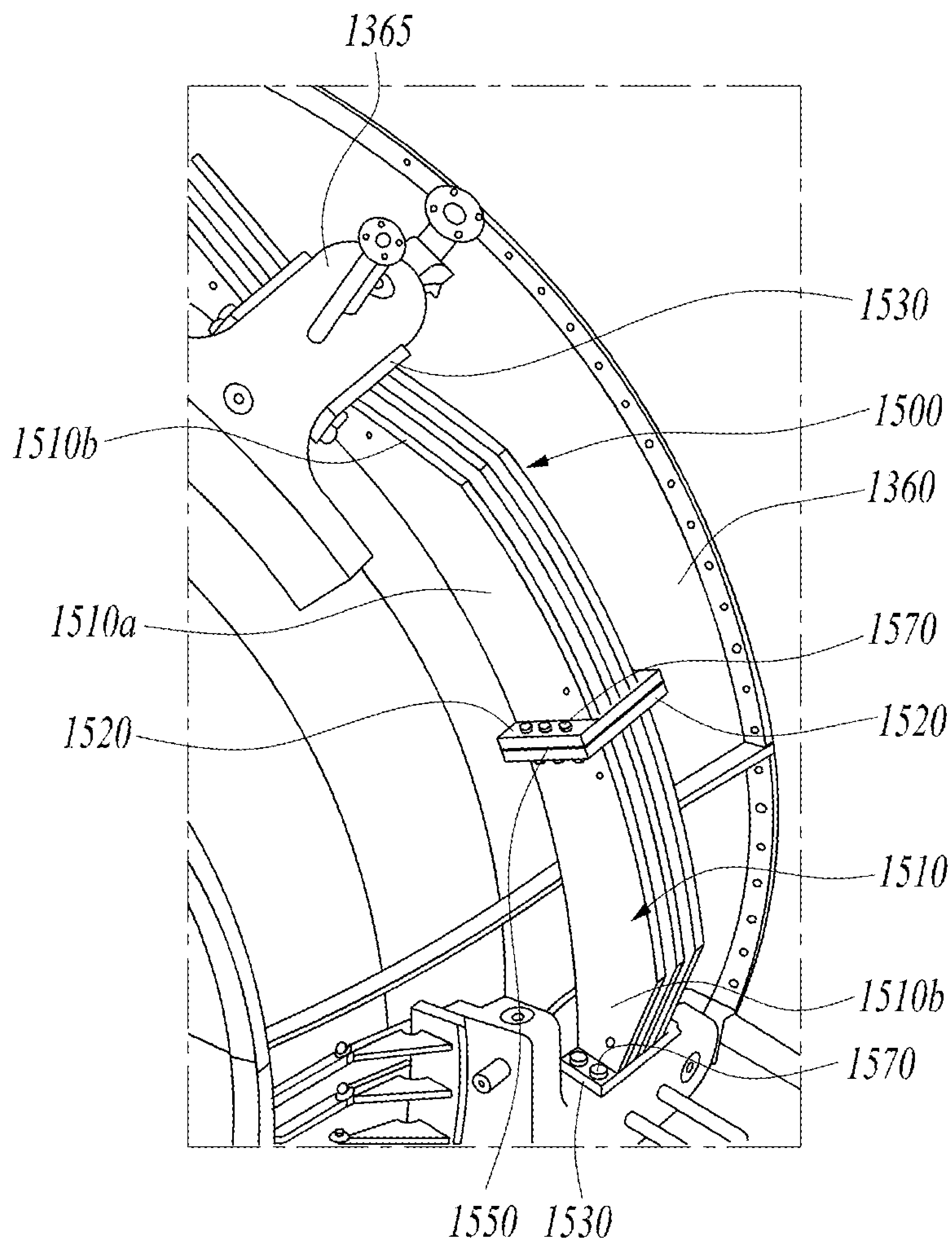

1365
1530
1500
1510b
1360
1510a
1570
1520
1520
1510
1510b
1570
1550
1530

FIG. 4

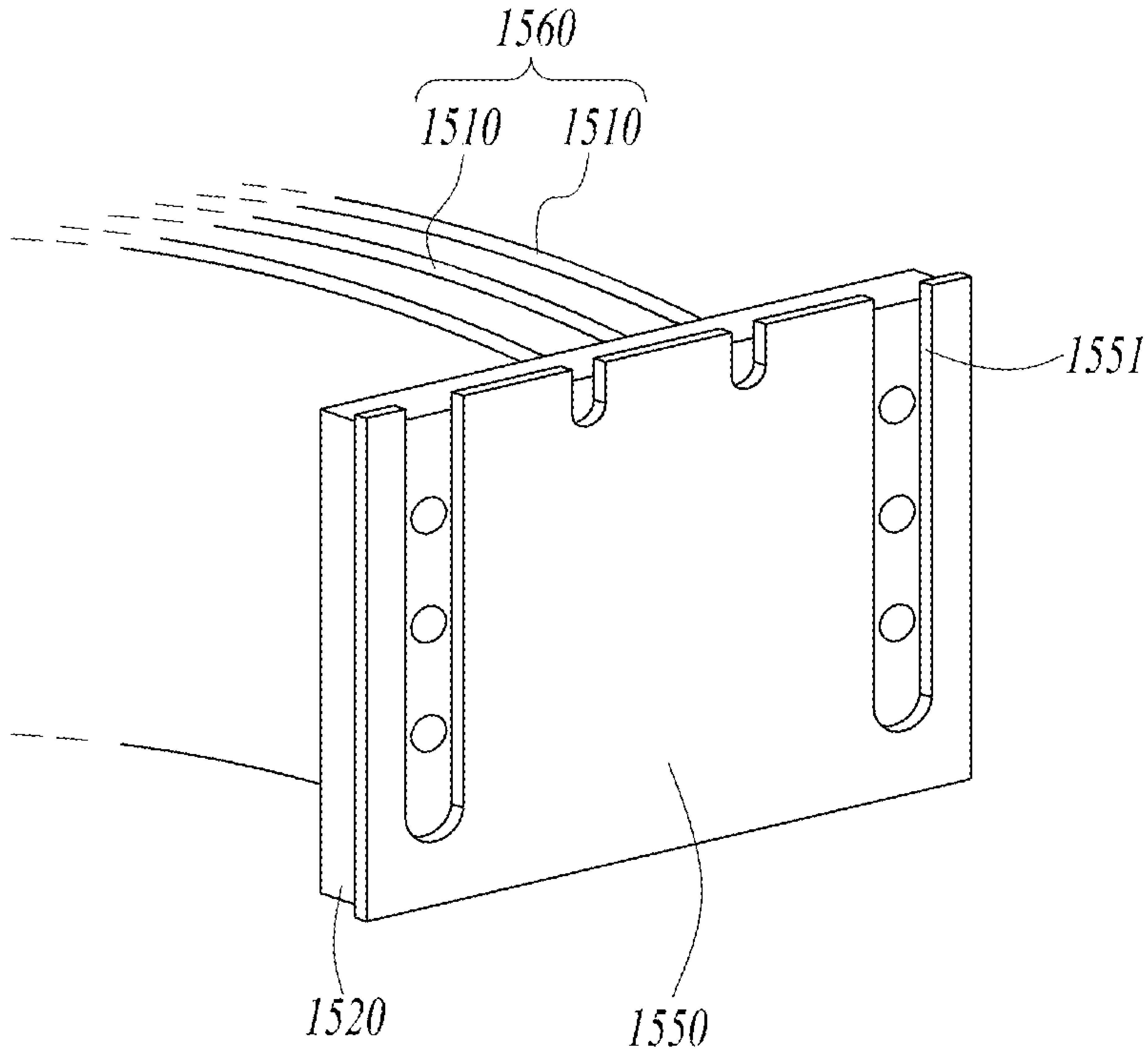


FIG. 5

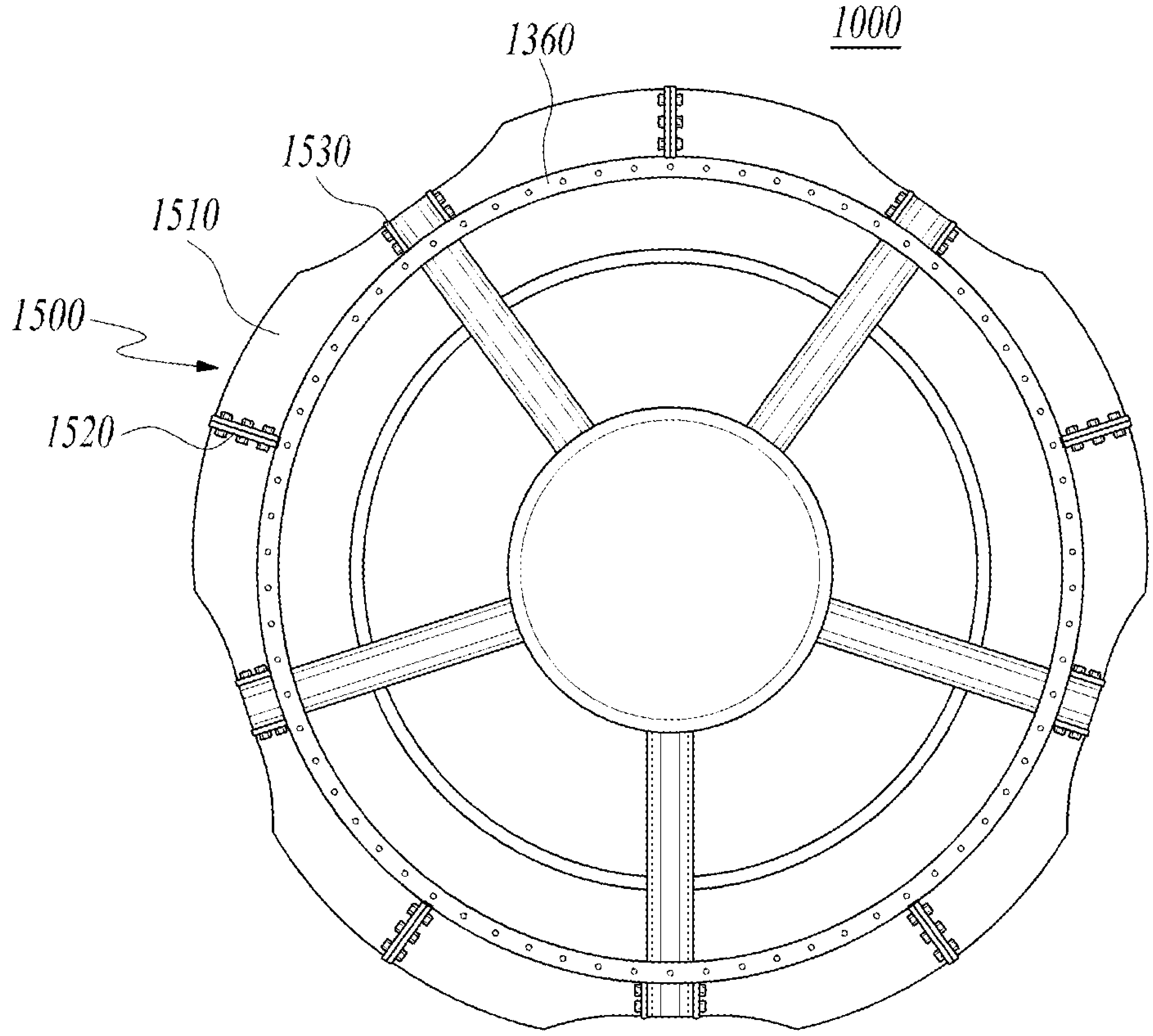


FIG. 6

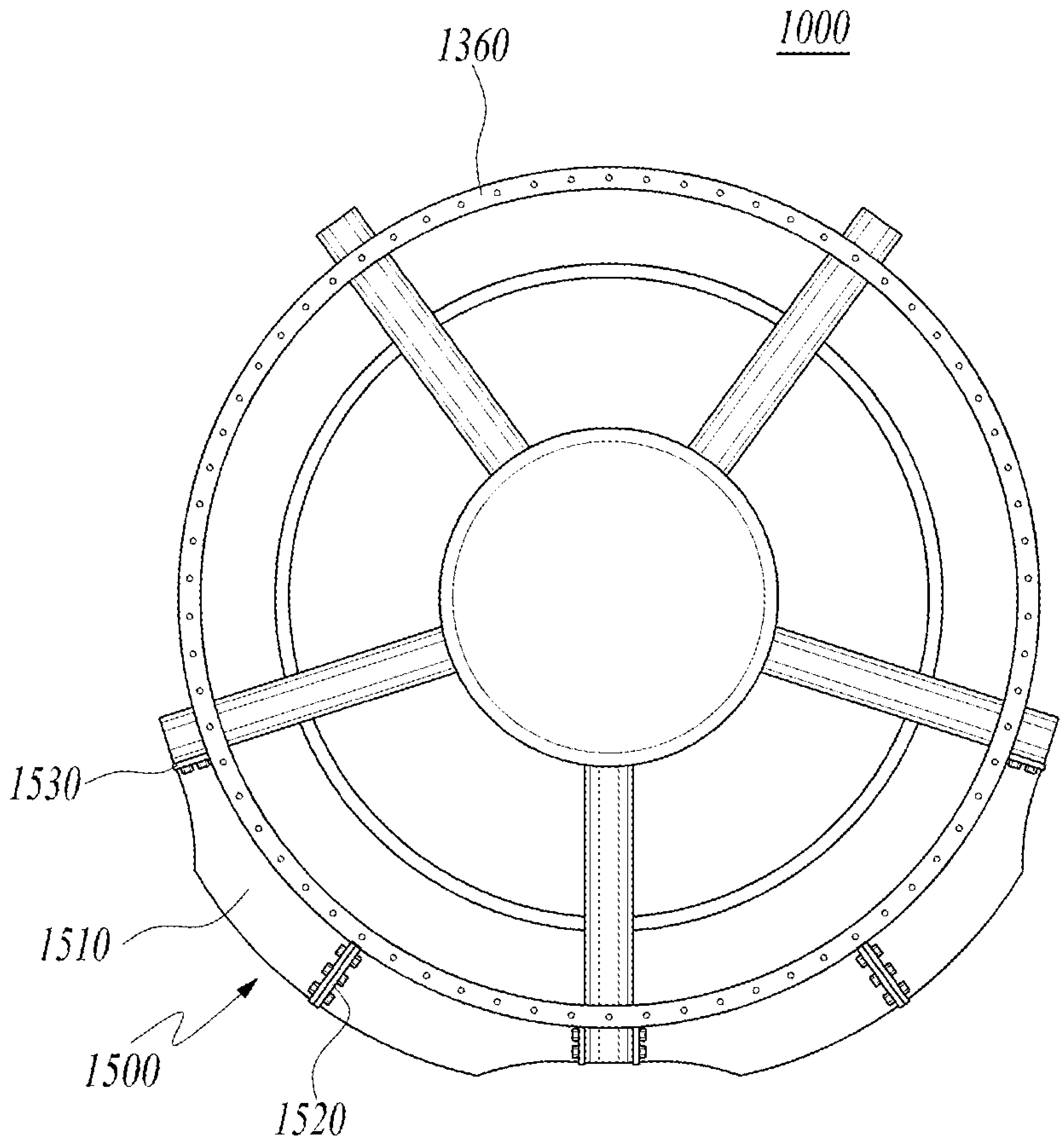


FIG. 7

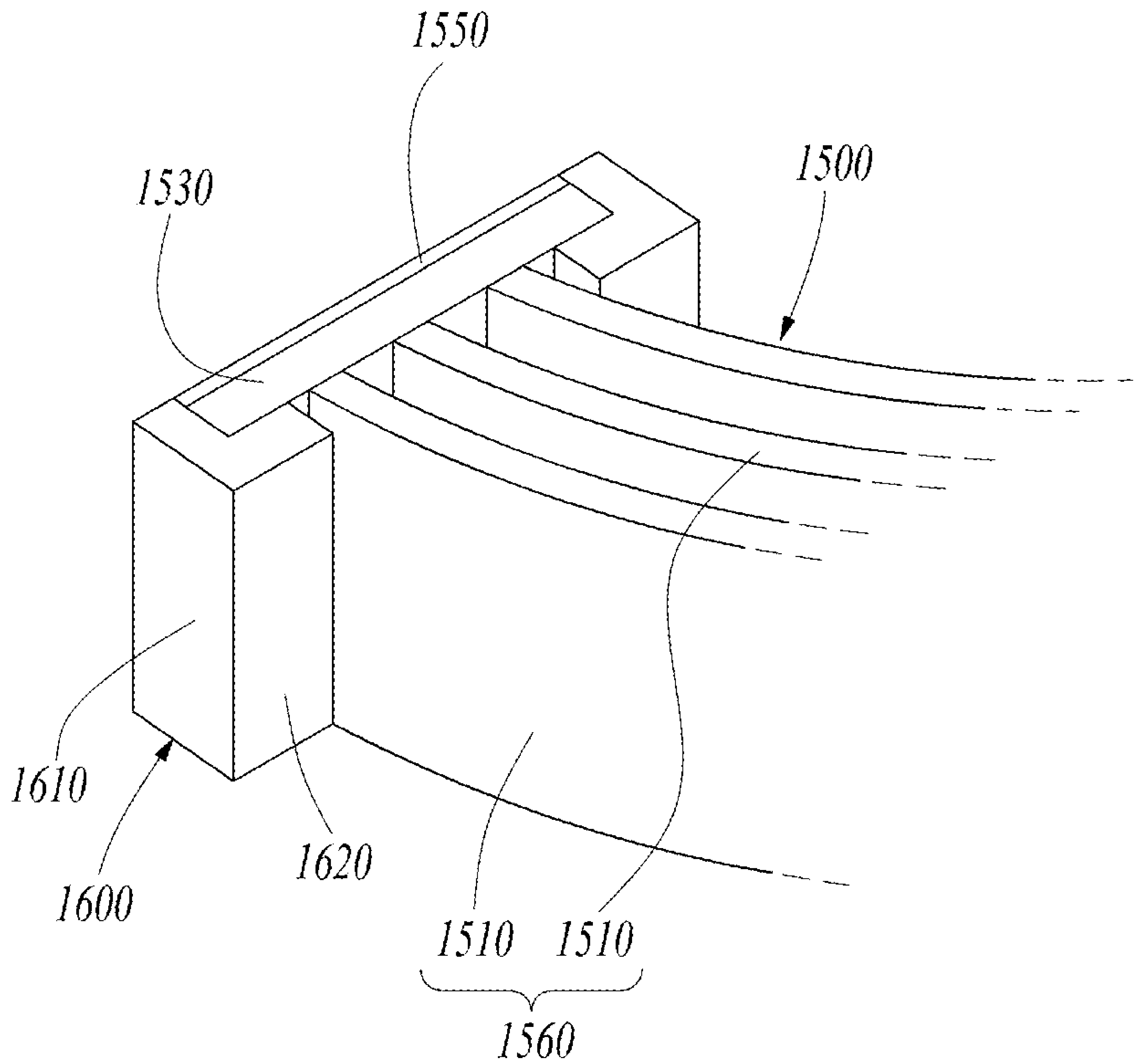


FIG. 8

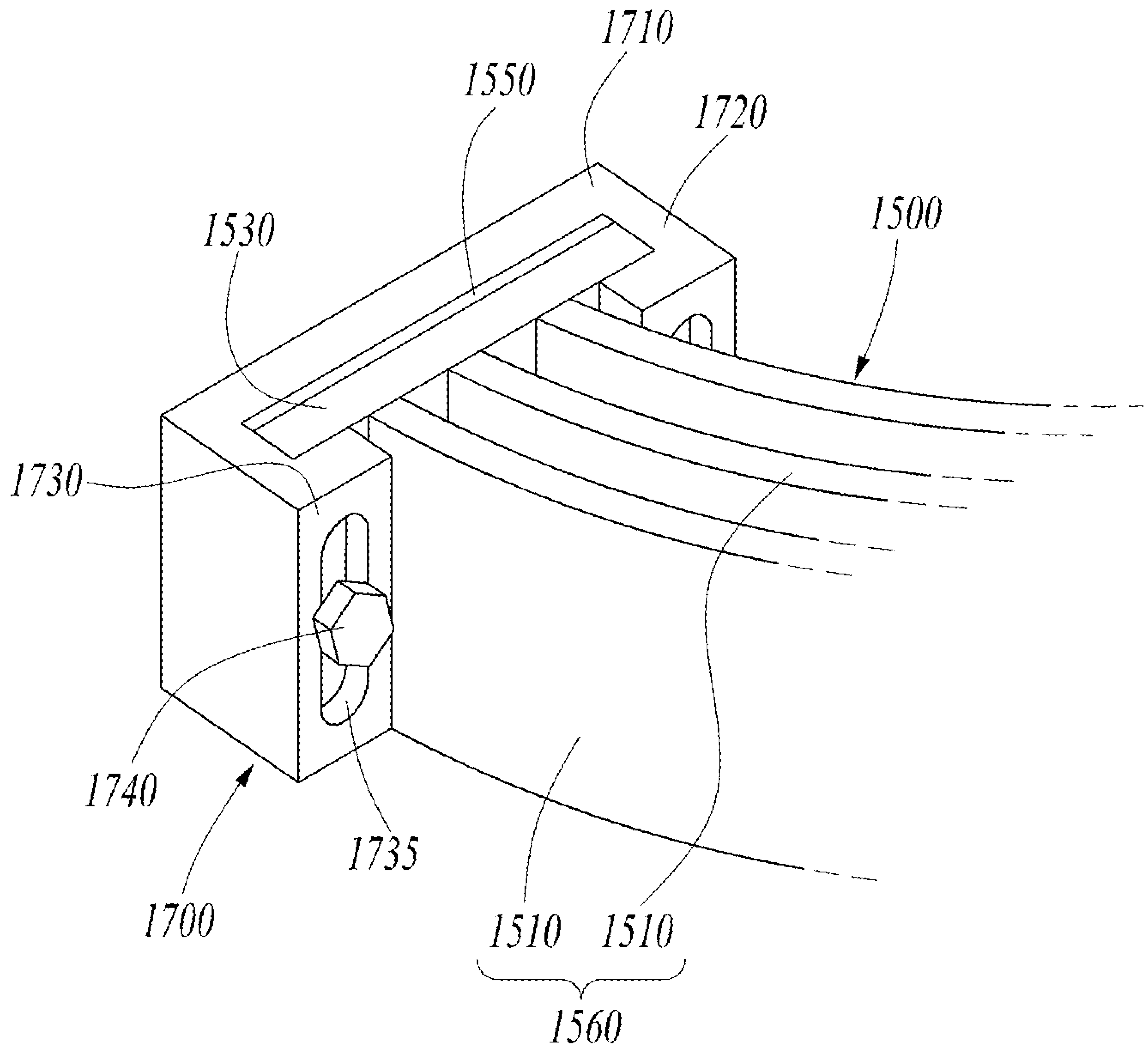
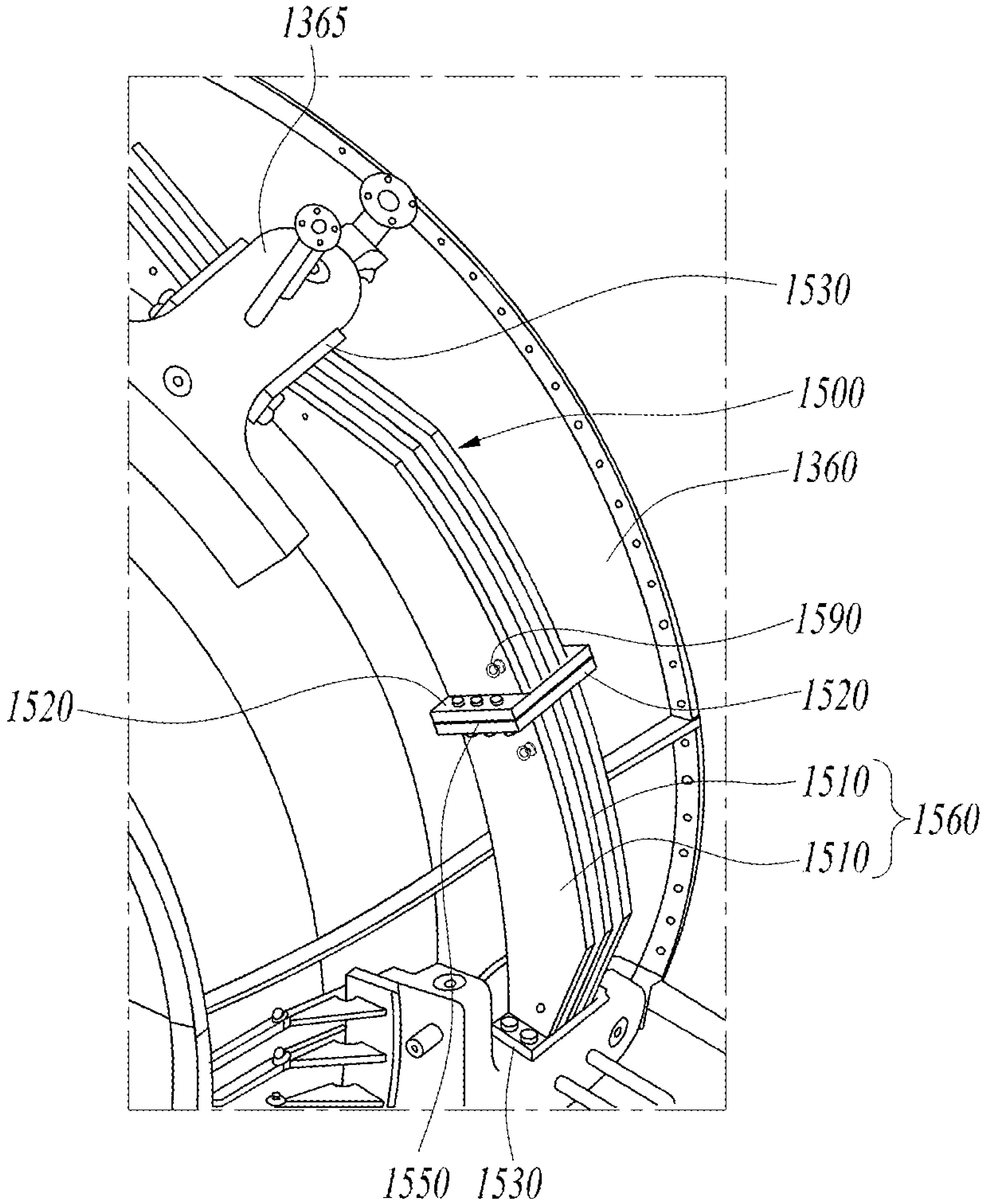


FIG. 9



VIBRATION DAMPER, EXHAUST DIFFUSER SYSTEM, AND GAS TURBINE INCLUDING SAME

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority to Korean Patent Application Nos. 10-2020-0117167, filed on Sep. 11, 2020 and 10-2020-0143684, filed on Oct. 30, 2020, the disclosures of which are incorporated herein by reference in their entireties.

BACKGROUND

1. Field

Apparatuses and methods consistent with exemplary embodiments relate to a vibration damper for damping vibrations, an exhaust diffuser system including the vibration damper, and a gas turbine including the exhaust diffuser system.

2. Description of the Related Art

A gas turbine is a combustion engine in which a mixture of air compressed by a compressor and fuel is combusted to produce a high temperature gas that drives a turbine. The gas turbine is used to drive electric generators, aircraft, ships, trains, or the like.

With prolonged use, the function of the gas turbine deteriorates, resulting in reduced strength and increased abnormal vibration of the casing. For example, much vibration may occur in an exhaust diffuser from which combustion gas is discharged in a turbine.

SUMMARY

Aspects of one or more exemplary embodiments provide a vibration damper capable of damping vibrations occurring from a turbine casing, an exhaust diffuser system including the vibration damper, and a gas turbine including the exhaust diffuser system.

Additional aspects will be set forth in part in the description which follows and, in part, will become apparent from the description, or may be learned by practice of the exemplary embodiments.

According to an aspect of an exemplary embodiment, there is provided a vibration damper installed on an outer casing of a gas turbine to damp vibrations generated in the gas turbine, the vibration damper including: a reinforcing support part including a plurality of reinforcing plates; a first flange coupled to both longitudinal ends of the reinforcing support part and fixed to a protruding support protruding from the outer casing; and a second flange disposed between the plurality of reinforcing plates to connect the plurality of reinforcing plates, wherein each of the plurality of reinforcing plates is erected and installed on an outer circumferential surface of the outer casing.

The plurality of reinforcing plates may be formed in an arc-shape.

The plurality of reinforcing plates may be arranged in parallel, and the first flange may be fixed to both longitudinal end sides of the plurality of reinforcing plates.

Two second flanges may be disposed to face each other and may be fixed to each other by a fastener.

A shim plate may be disposed between the second flanges to separate the second flanges.

The shim plate may be formed of a material having elasticity.

The shim plate may be formed of a metal.

The shim plate may include a slit into which the fastener is fitted.

The first flange may be installed on the protruding support by a sliding block while supporting the sliding block so as to be slidable in a radial direction of the outer casing.

The sliding block may include a side plate and a cover plate bent from an end of the side plate and extending parallel to the first flange, wherein the cover plate includes a long hole, and the first flange is provided with a guide pin passing through the long hole.

According to an aspect of another exemplary embodiment, there is provided an exhaust diffuser system of a gas turbine including: an outer casing and an inner casing defining an exhaust space; a plurality of struts connecting the outer casing and the inner casing; a plurality of protruding supports protruding outward from the outer casing; and a vibration damper installed on the outer casing to damp vibrations generated in a gas turbine, wherein the vibration damper includes: a reinforcing support part including a plurality of reinforcing plates, and a first flange coupled to both longitudinal ends of the reinforcing support part, wherein the plurality of reinforcing plates are fixed to the plurality of protruding supports so as to be erected on an outer circumferential surface of the outer casing.

Each of the plurality of struts may be fixed to an inner side of an associated one of the plurality of protruding supports.

Each of the plurality of reinforcing plates may include an arc-shaped central support portion and an outer support portion formed on both longitudinal end sides of the central support portion and having a height gradually decreasing toward a distal side.

The vibration damper may further include a second flange disposed between the plurality of reinforcing plates to connect the plurality of reinforcing plates, wherein two second flanges are disposed to face each other, and a shim plate is disposed between the second flanges to separate the second flanges, wherein the shim plate includes a slit into which a fastener is fitted.

The first flange may be installed on the protruding support by a sliding block while supporting the sliding block so as to be slidable in a radial direction of the outer casing.

The sliding block may include a side plate and a cover plate bent from an end of the side plate and extending parallel to the first flange, wherein the cover plate includes a long hole, and the first flange is provided with a guide pin passing through the long hole.

According to an aspect of another exemplary embodiment, there is provided a gas turbine including: a compressor configured to compress air introduced from an outside, a combustor configured to mix the air compressed by the compressor with fuel and combust an air-fuel mixture to produce high-temperature and high-pressure combustion gas, a turbine having a plurality of turbine blades rotating by the combustion gas produced by the combustor, and an exhaust diffuser system disposed on a rear side of the turbine to discharge gas, wherein the exhaust diffuser system includes: an outer casing and an inner casing defining an exhaust space; a plurality of struts connecting the outer casing and the inner casing; a plurality of protruding supports protruding outward from the outer casing; and a vibration damper installed on the outer casing to damp vibrations generated in a gas turbine, wherein the vibration damper includes: a reinforcing support part including a plurality of reinforcing plates, and a first flange coupled to both longitudinal ends of the reinforcing support part, wherein the plurality of reinforcing plates are fixed to the plurality of protruding supports so as to be erected on an outer circumferential surface of the outer casing.

Each of the plurality of struts may be fixed to an inner side of the protruding support.

The vibration damper may further include a second flange disposed between the plurality of reinforcing plates to connect the plurality of reinforcing plates, wherein two second flanges are disposed to face each other, and a shim plate is disposed between the second flanges to separate the second flanges, wherein the shim plate includes a slit into which a fastener is fitted.

The first flange may be installed on the protruding support by a sliding block while supporting the sliding block so as to be slidable in a radial direction of the outer casing, and the sliding block may include a side plate and a cover plate bent from an end of the side plate and extending parallel to the first flange, wherein the cover plate includes a long hole, and the first flange is provided with a guide pin passing through the long hole.

According to one or more exemplary embodiments, the vibration damper has an effect of reducing abnormal vibrations generated in a gas turbine and improving the strength of the turbine casing. In addition, because the exhaust diffuser system includes the strut, the protruding support, and the vibration damper, it is possible to reduce the abnormal vibration generated in the diffuser of the gas turbine and improve the strength of the turbine casing.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects will become more apparent from the following description of the exemplary embodiments with reference to the accompanying drawings, in which:

FIG. **1** is a view illustrating an interior of a gas turbine according to a first exemplary embodiment;

FIG. **2** is a longitudinal cross-sectional view illustrating a part of the gas turbine of FIG. **1**;

FIG. **3** is an enlarged view illustrating a state in which a vibration damper according to the first exemplary embodiment is installed;

FIG. **4** is a perspective view illustrating a part of the vibration damper according to the first exemplary embodiment;

FIG. **5** is a bottom view illustrating the gas turbine according to the first exemplary embodiment;

FIG. **6** is a bottom view illustrating a gas turbine according to a modification of the first exemplary embodiment;

FIG. **7** is a view illustrating a state in which a vibration damper is installed in the gas turbine according to a second exemplary embodiment;

FIG. **8** is a view illustrating a state in which a vibration damper is installed in the gas turbine according to a third exemplary embodiment; and

FIG. **9** is an enlarged view illustrating a state in which a vibration damper according to a fourth exemplary embodiment is installed.

DETAILED DESCRIPTION

Various modifications and various embodiments will be described in detail with reference to the accompanying drawings. However, it should be noted that various embodiments are not limiting the scope of the disclosure to the specific embodiment, and they should be interpreted to include all modifications, equivalents, or substitutions of the embodiments included within the spirit and scope disclosed herein.

Terms used herein are used to merely describe specific embodiments, and are not intended to limit the scope of the disclosure. As used herein, an element expressed as a singular form includes a plurality of elements, unless the context clearly indicates otherwise. Further, it will be understood that the term "comprising" or "including" specifies the presence of stated features, numbers, steps, operations, elements, parts, or combinations thereof, but does not preclude the presence or addition of one or more other features, numbers, steps, operations, elements, parts, or combinations thereof.

Hereinafter, exemplary embodiments will be described in detail with reference to the accompanying drawings. It is noted that like reference numerals refer to like parts throughout the various figures and exemplary embodiments. In certain embodiments, the detailed description of known functions and configurations that may obscure the gist of the present disclosure will be omitted. For the same reason, some of the elements in the drawings are exaggerated, omitted, or schematically illustrated.

Hereinafter, a gas turbine according to a first exemplary embodiment will be described with reference to the accompanying drawings.

FIG. **1** is a view illustrating an interior of a gas turbine according to an exemplary embodiment, and FIG. **2** is a longitudinal cross-sectional view of the gas turbine of FIG. **1**.

Referring to FIGS. **1** and **2**, an ideal thermodynamic cycle of a gas turbine **1000** may comply with the Brayton cycle. The Brayton cycle consists of four thermodynamic processes: an isentropic compression (i.e., an adiabatic compression) process, an isobaric combustion process, an isentropic expansion (i.e., an adiabatic expansion) process, and isobaric heat ejection process. That is, in the Brayton cycle, thermal energy may be released by combustion of fuel in an isobaric environment after atmospheric air is sucked and compressed into high pressure air, hot combustion gas may be expanded to be converted into kinetic energy, and exhaust gas with residual energy may be discharged to the outside. As such, the Brayton cycle consists of four thermodynamic processes: compression, heating, expansion, and exhaust.

The gas turbine **1000** employing the Brayton cycle includes a compressor **1100**, a combustor **1200**, a turbine **1300**, and an exhaust diffuser system **1800**. Although the following description will be described with reference to FIG. **1**, the present disclosure may be widely applied to other turbine engines similar to the gas turbine **1000** illustrated in FIG. **1**.

Referring to FIG. **1**, the compressor **1100** may suck and compress air. The compressor **1100** may supply the compressed air by compressor blades **1130** to a combustor **1200** and also supply cooling air to a high temperature region of the gas turbine **1000**. Here, because the sucked air is compressed in the compressor **1100** through an adiabatic compression process, the pressure and temperature of the air passing through the compressor **1100** increases.

The compressor **1100** may be designed in the form of a centrifugal compressor or an axial compressor, wherein the centrifugal compressor is applied to a small-scale gas turbine, whereas a multi-stage axial compressor is applied to a large-scale gas turbine **1000** illustrated in FIG. **1** to compress a large amount of air. In the multi-stage axial compressor

1100, the compressor blades **1130** rotate according to the rotation of a central tie rod **1120** and rotor disks, compress the introduced air and move the compressed air to the compressor vane **1140** disposed at a following stage. The air is compressed gradually to a high pressure while passing through the compressor blades **1130** formed in multiple stages.

The compressor vanes **1140** are mounted inside a housing **1150** in such a way that a plurality of compressor vanes **1140** form each stage. The compressor vanes **1140** guide the compressed air moved from the compressor blade **1130** disposed at a preceding stage toward the compressor blade **1130** disposed at a following stage. For example, at least some of the compressor vanes **1140** may be mounted so as to be rotatable within a predetermined range, e.g., to adjust an air inflow. In addition, guide vanes **1180** may be provided in the compressor **1100** to control a flow rate of air introduced into the compressor **1100**.

The compressor **1100** may be driven using a portion of the power output from the turbine **1300**. To this end, as illustrated in FIG. **1**, a rotary shaft of the compressor **1100** and a rotary shaft of the turbine **1300** may be directly connected by a torque tube **1170**. In the case of the large-scale gas turbine **1000**, almost half of the output produced by the turbine **1300** may be consumed to drive the compressor **1100**.

The combustor **1200** may mix compressed air supplied from an outlet of the compressor **1100** with fuel and combust the air-fuel mixture at a constant pressure to produce a high-energy combustion gas. That is, the combustor **1200** mixes the compressed air with fuel, combusts the mixture to produce a high-temperature and high-pressure combustion gas with high energy, and increases the temperature of the combustion gas, through an isobaric combustion process, to a temperature at which the combustor and turbine parts can withstand without being thermally damaged.

The combustor **1200** may include a plurality of burners arranged in a housing formed in a cell shape and having a fuel injection nozzle, a combustor liner forming a combustion chamber, and a transition piece as a connection between the combustor and the turbine.

The high-temperature and high-pressure combustion gas ejected from the combustor **1200** is supplied to the turbine **1300**. As the supplied high-temperature and high-pressure combustion gas expands, impulse and impact forces are applied to the turbine blades **1330** to generate rotational torque. A portion of the rotational torque is transferred to the compressor **1100** through the torque tube **1170**, and remaining portion which is an excessive torque is used to drive a generator, or the like.

The turbine **1300** includes a rotor disk **1310**, a plurality of turbine blades **1330** and turbine vanes **1320** arranged radially on the rotor disk **1310**, and a ring segment **1350** disposed around the turbine blades **1330**. The rotor disk **1310** has a substantially disk shape, and a plurality of grooves are formed in an outer circumferential portion thereof. The grooves are formed to have a curved surface so that the turbine blades **1330** are inserted into the grooves, and the turbine vanes **1320** are mounted in a turbine casing. The turbine blades **1330** may be coupled to the rotor disk **1310** in a manner such as a dovetail connection. The turbine vanes **1320** are fixed so as not to rotate and guide a flow direction of the combustion gas passing through the turbine blades **1330**. The ring segment **1350** may be provided around the turbine blades **1330** to maintain a sealing function. A plurality of ring segments **1350** may be disposed circumferentially around the turbine **1300** to form a ring assembly.

The exhaust diffuser system **1800** is installed on a rear side of the gas turbine **1000** and discharges combustion gas discharged from the turbine **1300**. The exhaust diffuser system **1800** may include an outer casing **1360**, an inner casing **1380**, a strut **1400**, a protruding support **1365**, and a vibration damper **1500**.

The outer casing **1360** has a cylindrical shape that forms an external contour and prevents leakage of gas. The outer casing **1360** may have a circular longitudinal section. The outer casing **1360** surrounds the compressor **1100** and the turbine **1300**, and forms an exhaust space ES on a rear side of the turbine **1300**. The outer casing **1360** may be formed such that an inner diameter gradually increases toward the rear side.

The inner casing **1380** is spaced apart from the outer casing **1360** to form an annular exhaust space ES, and may be formed in a conical shape with an inner diameter gradually decreasing toward the rear side. Accordingly, cross-sectional area of the exhaust space ES may gradually increase toward the rear side.

A plurality of protruding supports **1365** are formed on an outer circumferential surface of the outer casing **1360**, and may be spaced apart from each other in the circumferential direction of the outer casing **1360**. However, the present disclosure is not limited thereto, and the protruding support may protrude from an inner circumferential surface of the outer casing. The protruding support **1365** may be formed in a substantially T-shape.

The strut **1400** is fixed to the inner side of the protruding support **1365** to connect the outer casing **1360** and the inner casing **1380**. A plurality of struts **1400** may be spaced apart from each other in the circumferential direction of the turbine **1300**. The strut **1400** damps the vibration generated in the outer casing **1360** together with the inner casing **1380**.

FIG. **3** is an enlarged view illustrating a state in which a vibration damper according to the first exemplary embodiment is installed, and FIG. **4** is a perspective view illustrating a part of the vibration damper according to the first exemplary embodiment.

Referring to FIGS. **3** and **4**, the vibration damper **1500** includes a reinforcing support part **1560** including a plurality of reinforcing plates **1510**, a first flange **1530** coupled to both longitudinal ends of the reinforcing support part **1560** so as to be fixed to the protruding support **1365** protruding from the outer circumferential surface of the outer casing **1360**, a second flange **1520** disposed between the reinforcing plates **1510** to connect the reinforcing plates **1510**, and a shim plate **1550** that contacts and supports the first flange **1530** and the second flange **1520**.

The reinforcing support part **1560** includes the plurality of reinforcing plates **1510** disposed to face each other. The reinforcing support part **1560** may circumferentially support the outer casing **1360** to prevent the outer casing **1360** from shaking.

In addition, the reinforcing plates **1510** may be spaced apart in the longitudinal direction with the second flange **1520** interposed therebetween. The reinforcing plates **1510** are formed in an arc shape, and may be erected and installed with respect to the outer circumferential surface of the outer casing **1360**. However, the present disclosure is not limited thereto, and the vibration damper **1500** may be fixed to the inner circumferential surface of the outer casing **1360**.

The reinforcing plate **1510** may include an arc-shaped central support portion **1510***a* and outer support portions

1510*b* formed on both longitudinal end sides of the central support portion **1510***a* and having a height gradually decreasing toward a distal end side. If the reinforcing plate **1510** includes the central support portion **1510***a* and the outer support portions **1510***b*, vibration may be more efficiently reduced. In addition, an inner surface of the reinforcing plate **1510** may be spaced apart from the outer surface of the outer casing **1360**.

The vibration damper **1500** may be fixed to the outer casing **1360** at a portion in which the turbine **1300** is located, and e.g., may be installed in an exhaust region in which gas is discharged from the turbine **1300**.

The first flange **1530** is erected perpendicular to a longitudinal end of the reinforcing plate **1510** and may be fixed to the protruding support **1365** by a fastener **1570**. For example, the fastener **1570** may be formed of a bolt. The shim plate **1550** may be installed between the first flange **1530** and the protruding support **1365**.

The second flange **1520** is disposed between the reinforcing plates **1510** to connect the reinforcing plates **1510**, and two adjacent second flanges **1520** are disposed to face each other and are fixed by a fastener **1570**. The second flange **1520** may be vertically fixed to the longitudinal end of the reinforcing plate **1510** to connect the reinforcing plates **1510**.

The shim plate **1550** is installed between the second flanges **1520**. Here, a plurality of shim plates **1550** may be installed depending on a distance between the second flanges **1520**. The shim plate **1550** may be formed of elastic rubber, silicone, or the like. Accordingly, vibration characteristics of the outer casing **1360** may be improved by the shim plate **1550**. In addition, the shim plate **1550** may be formed of a metal such as carbon steel, stainless steel, or the like.

Two slits **1551** are formed in the shim plate **1550**, and a plurality of fasteners **1570** may be inserted into the slits **1551**. Accordingly, the shim plate **1550** may be easily assembled and disassembled using the slits **1551** without completely removing the fasteners **1570** from the first flange **1530** and the second flange **1520**. When the shim plate **1550** is assembled, an installation error may be corrected, and vibration characteristics of the outer casing **1360** may be improved by the shim plate **1550**.

The shim plate **1550** assembled between the first flanges **1530** and the shim plate **1550** assembled between the second flanges **1520** may be formed of different materials. For example, the shim plate **1550** assembled between the first flanges **1530** may be formed of a material having elasticity, and the shim plate assembled between the second flanges **1520** may be formed of metal.

When the shim plate **1550** is installed so as to abut against the first flange **1530** and the second flange **1520**, vibration can be damped from the outside and inside of the vibration damper **1500**, thereby improving the vibration damping performance.

FIG. **5** is a bottom view illustrating the gas turbine according to the first exemplary embodiment, and FIG. **6** is a bottom view illustrating a gas turbine according to a modification of the first exemplary embodiment.

Referring to FIG. **5**, the vibration damper **1500** may be arranged around the entire circumference of the outer casing **1360** to surround the outer casing **1360**. Alternatively, the vibration damper **1500** may be installed only on a part of the outer casing **1360**.

If the vibration damper **1500** is installed as in the first exemplary embodiment, the structural strength of the outer casing **1360** may be improved, and the vibration characteristics of the outer casing **1360** may also be improved. For example, at the outlet side of the turbine **1300**, vibration may increase due to deterioration of the turbine **1300**, and the vibration damper **1500** may significantly reduce vibration occurring due to the deterioration of the turbine **1300**. In addition, the vibration damper **1500** may be connected to the inner casing **1380** via the protruding support **1365** and the strut **1400** to more effectively reduce the vibration of the outer casing **1360**.

Hereinafter, a gas turbine according to a second exemplary embodiment will be described. FIG. **7** is a view illustrating a state in which a vibration damper is installed in the gas turbine according to a second exemplary embodiment.

Referring to FIG. **7**, the gas turbine according to the second exemplary embodiment has the same structure as the gas turbine according to the first exemplary embodiment except for sliding block **1600**, so a redundant description of the same configuration will be omitted.

The vibration damper **1500** according to the second exemplary embodiment may further include a sliding block **1600** supporting the first flange **1530**. The first flange **1530** may be fixed to the outer casing **1360** through the sliding block **1600**. The sliding block **1600** includes side plates **1610** abutting against sides of the first flange **1530** and cover plates **1620** bent from the side plates **1610** and extending parallel to the first flange **1530**, and the first flange **1530** is inserted into grooves defined by the side plates **1610** and the cover plates **1620**. The sliding block **1600** supports the first flange **1530** to be slidable in the radial direction of the outer casing **1360**. Although the sliding block **1600** may have a structure in which the outer end side is open in FIG. **7**, the present disclosure is not limited thereto, and the sliding block **1600** may have various structures having a groove through which the first flange **1530** moves.

When the sliding block **1600** is installed as in the second exemplary embodiment, if the outer casing **1360** expands due to heat, the vibration damper **1500** may be pushed outward, and if the outer casing **1360** is cooled and contracts, the vibration damper **1500** may be moved inward.

Hereinafter, a gas turbine according to a third exemplary embodiment will be described. FIG. **8** is a view illustrating a state in which a vibration damper is installed in the gas turbine according to a third exemplary embodiment.

Referring to FIG. **8**, the gas turbine according to the third exemplary embodiment has the same structure as the gas turbine according to the first exemplary embodiment except for a sliding block **1700**, so a redundant description of the same configuration will be omitted.

The first flange **1530** may be fixed to the outer casing **1360** via the sliding block **1700**. The sliding block **1700** includes a base plate **1710** abutting against the protruding support **1365**, side plates **1720** protruding from both ends of the base plate **1710**, and cover plates **1730** bent from ends of the side plates **1720**. The first flange **1530** is inserted into grooves defined by the base plate **1710**, the side plates **1720**, and the cover plates **1730**. The cover plates **1730** extend parallel to the first flange **1530** to surround the first flange **1530** to prevent the first flange **1530** from being detached. The shim plate **1550** may be disposed between the base plate **1710** and the first flange **1530**.

A long hole **1735** extending in a height direction of the cover plate **1730** is formed in the cover plate **1730**, and a guide pin **1740** is provided on the first flange **1530** to pass through the long hole **1735**. Accordingly, the first flange

1530 may be easily slidable in the radial direction of the outer casing 1360 by being guided by the long hole 1735 and the guide pin 1740.

Hereinafter, a gas turbine according to a fourth exemplary embodiment will be described. FIG. 9 is an enlarged view illustrating a state in which a vibration damper according to a fourth exemplary embodiment is installed.

Referring to FIG. 9, the gas turbine according to the fourth exemplary embodiment has the same structure as the gas turbine according to the first exemplary embodiment, except for ring jig 1590, so a redundant description of the same configuration will be omitted.

The ring jig 1590 may be installed on the reinforcing plate 1510. When installing the ring jig 1590, the vibration damper 1500 may be easily installed by connecting a cable to the ring jig 1590. In addition, the outer casing 1360 may be lifted through the vibration damper 1500 by connecting the cable to the ring jig 1590.

While one or more exemplary embodiments have been described with reference to the accompanying drawings, it will be apparent to those skilled in the art that various modifications and variations can be made through addition, change, omission, or substitution of components without departing from the spirit and scope of the disclosure as set forth in the appended claims, and these modifications and changes fall within the spirit and scope of the disclosure as defined in the appended claims.

What is claimed is:

1. A vibration damper installed on an outer casing of a gas turbine to damp vibrations generated in the gas turbine, the vibration damper comprising:

a reinforcing support part comprising a plurality of reinforcing plates;

a pair of first flanges, each first flange coupled to either one of two longitudinal ends of the reinforcing support part and fixed to a protruding support protruding from the outer casing; and

two second flanges disposed between the plurality of reinforcing plates to connect the plurality of reinforcing plates,

wherein each of the plurality of reinforcing plates is erected and installed on an outer circumferential surface of the outer casing,

wherein the two second flanges are disposed to face each other and are fixed to each other by a fastener.

2. The vibration damper according to claim 1, wherein each of the plurality of reinforcing plates is formed in an arc-shape.

3. The vibration damper according to claim 1, wherein the plurality of reinforcing plates are arranged in parallel, and the pair of first flanges is fixed to both longitudinal end sides of the plurality of reinforcing plates.

4. The vibration damper according to claim 1, wherein a shim plate is disposed between the second flanges to separate the second flanges.

5. The vibration damper according to claim 4, wherein the shim plate is formed of a material having elasticity.

6. The vibration damper according to claim 4, wherein the shim plate is formed of a metal.

7. The vibration damper according to claim 4, wherein the shim plate includes a slit into which the fastener is fitted.

8. The vibration damper according to claim 1, wherein each first flange is installed on the protruding support by a sliding block while supporting the sliding block so as to be slidable in a radial direction of the outer casing.

9. The vibration damper according to claim 8, wherein the sliding block comprises a side plate and a cover plate bent from an end of the side plate and extending parallel to each first flange,

wherein the cover plate includes a slot, and each first flange is provided with a guide pin passing through the slot.

10. An exhaust diffuser system for a gas turbine, the system comprising:

an outer casing and an inner casing defining an exhaust space;

a plurality of struts connecting the outer casing and the inner casing;

a plurality of protruding supports protruding outward from the outer casing; and

a vibration damper installed on the outer casing to damp vibrations generated in a gas turbine,

wherein the vibration damper comprises:

a reinforcing support part comprising a plurality of reinforcing plates; and

a pair of first flanges, each first flange coupled to either one of two longitudinal ends of the reinforcing support part,

wherein the plurality of reinforcing plates are fixed to the plurality of protruding supports so as to be erected on an outer circumferential surface of the outer casing,

wherein the vibration damper further comprises two second flanges disposed between the plurality of reinforcing plates to connect the plurality of reinforcing plates.

11. The exhaust diffuser system according to claim 10, wherein each of the plurality of struts is fixed to an inner side of an associated one of the plurality of protruding supports.

12. The exhaust diffuser system according to claim 10, wherein each of the plurality of reinforcing plates comprises an arc-shaped central support portion and an outer support portion formed on both longitudinal end sides of the central support portion and having a height gradually decreasing toward a distal side.

13. The exhaust diffuser system according to claim 10,

wherein the two second flanges are disposed to face each other, and a shim plate is disposed between the second flanges to separate the second flanges, and

wherein the shim plate includes a slit into which a fastener is fitted.

14. The exhaust diffuser system according to claim 10, wherein each first flange is installed on an associated one of the plurality of protruding supports by a sliding block while supporting the sliding block so as to be slidable in a radial direction of the outer casing.

15. The exhaust diffuser system according to claim 14, wherein the sliding block comprises a side plate and a cover plate bent from an end of the side plate and extending parallel to each first flange,

wherein the cover plate includes a slot, and each first flange is provided with a guide pin passing through the slot.

16. A gas turbine comprising:

a compressor configured to compress air introduced from an outside,

a combustor configured to mix the air compressed by the compressor with fuel and combust an air-fuel mixture to produce high-temperature and high-pressure combustion gas,

a turbine having a plurality of turbine blades rotating by the combustion gas produced by the combustor, and

an exhaust diffuser system disposed on a rear side of the turbine to discharge gas, wherein the exhaust diffuser system comprises:

an outer casing and an inner casing defining an exhaust space;

a plurality of struts connecting the outer casing and the inner casing;

a plurality of protruding supports protruding outward from the outer casing; and

a vibration damper installed on the outer casing to damp vibrations generated in a gas turbine,

wherein the vibration damper comprises:

a reinforcing support part comprising a plurality of reinforcing plates; and

a pair of first flanges, each first flange coupled to either one of two longitudinal ends of the reinforcing support part,

wherein the plurality of reinforcing plates are fixed to the plurality of protruding supports so as to be erected on an outer circumferential surface of the outer casing.

17. The gas turbine according to claim **16**, wherein each of the plurality of struts is fixed to an inner side of an associated one of the plurality of protruding supports.

18. The gas turbine according to claim **16**, wherein the vibration damper further comprises two second flanges disposed between the plurality of reinforcing plates to connect the plurality of reinforcing plates,

wherein the two second flanges are disposed to face each other, and a shim plate is disposed between the second flanges to separate the two second flanges, and

wherein the shim plate includes a slit into which a fastener is fitted.

19. The gas turbine according to claim **16**, wherein each first flange is installed on an associated one of the plurality of protruding supports by a sliding block while supporting the sliding block so as to be slidable in a radial direction of the outer casing, and the sliding block comprises a side plate and a cover plate bent from an end of the side plate and extending parallel to each first flange,

wherein the cover plate includes a slot, and each first flange is provided with a guide pin passing through the slot.

20. The gas turbine according to claim **16**, wherein the vibration damper further comprises two second flange disposed between the plurality of reinforcing plates to connect the plurality of reinforcing plates.

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